Evaluation of two supplements for the prevention of alfalfa bloat

John W. Hall, Ian Walker, Walter Majak

Abstract

Poloxalene and a mineral mixture feed supplement patented for the treatment of emphysema, polyarthritis, and other pectin related diseases were tested in two trials for their ability to prevent bloat in cattle fed fresh alfalfa. Each trial had a crossover design using three Jersey steers with rumen fistulas per group. Each trial period continued until the total number of cases of bloat reached ≥24. Treatments were given at 0800 each day. The mineral mixture was given at 100 g/d and 190 mg/kg body weight per day in the first and second trials, respectively. Poloxalene, which was tested only in the second trial, was given at 23 mg/kg body weight per day. Each group of steers was then fed 200 kg of freshly harvested alfalfa in the vegetative to early bloom stages of growth at 0830. In the first trial, only 69% as many cases of bloat occurred on the mineral mixture as on the control treatment, but no significant difference was detected in the second trial. The potency of the alfalfa may have been higher in the second trial, when forage dry matter was lower, magnesium and soluble nitrogen were higher, and bloat occasionally occurred twice a day. Bloat did not occur when the steers were treated with poloxalene. In these trials, poloxalene was completely effective in preventing bloat, but the mineral mixture was only partially so.

Résumé

Évaluation de deux(2) additifs alimentaires afin de prévenir la distension gastrique causée par la luzerne

La poloxalène et un mélange de minéraux brevetés comme additifs alimentaires pour le traitement de l'emphysème, de la polyarthrite et de maladies reliées à la pectine ont été évalués dans deux(2) protocoles pour déterminer leur potentiel protecteur contre le ballonnement chez les bouvillons alimentés avec de la luzeme fraîche. Chaque essai était conçu sur un modèle de regroupement et comptait trois(3) Jersey par groupe ayant une fistule du rumen. Chaque essai s'est poursuivi jusqu'à ce que le nombre total de distension gastrique soit ≥ 24. Les traitements ont été administrés à 8 h 00 chaque matin. La quantité de minéraux donnée correspondait à 100 g/j lors du premier essai et à 190 mg/kg de poids corporel par jour pour le second essai. La poloxalène a été utilisé seulement lors du deuxième essai à raison de 23 mg/kg de poids corporel par jour. Chaque groupe de bouvillons a été nourri avec 200 kg de luzeme fraîche cueillie le matin à 8 h 30. La luzeme était en phase de croissance végétale ou en début de floraison. Lors du premier essai, le nombre de cas dans le groupe traité avec le supplément de minéraux qui ont présenté une distension gastrique était équivalent à 69 % du nombre de cas de distension du groupe témoin. Toutefois, il n'y a pas eu de différence significative entre les groupes lors du deuxième essai. Le potentiel de la luzerne à promouvoir le ballonnement était peut-être plus élevé lors du deuxième essai, alors que le taux de matière sèche du fourrage était plus bas, et que les taux de magnésium et l'azote liquide étaient plus élevés. La distension gastrique se produisait à l'occasion jusqu'à deux fois par jour. Le ballonnement ne s'est pas produit chez les bouvillons traités avec du poloxalène. Lors de ces essais, le poloxalène a été complètement efficace dans la prévention du ballonnement, alors que le mélange de minéraux n'a été que partiellement efficace.

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Introduction

Bloat can occur among ruminants grazing pastures of legumes, such as alfalfa (*Medicago sativa* L.), and is most likely to occur when the alfalfa is in its vegetative to midbud stages and is growing rapidly. Even under these conditions, the occurrence of bloat is sporadic. Cattle fed once a day exclusively on chopped alfalfa harvested in these early stages of growth may bloat as little as 33% of the time (1).

Feed supplements are often used in an attempt to prevent bloat. One supplement (Silent Herder Mineral Mix (SHMM), Anderson Laboratories, Bozeman, Montana, USA) has been patented for the treatment of emphysema, polyarthritis, and "other pectin related diseases," including bloat in ruminants (2). An evaluation of its efficacy as a treatment for locoweed (*Oxytropis sericea*) toxicosis in cattle was recently reported, and the elemental composition of SHMM has been described (3). Pectin, which is degraded in the rumen, is not a primary foaming agent but can act as a foam stabilizer (4). To our knowledge, no scientific investigation of the effectiveness of SHMM for preventing bloat has been published. The increasing use of SHMM for bloat prevention by producers in western Canada and the United States, and a recent report of deaths in cattle that had access to it while grazing alfalfa (5), suggested the need for an evaluation of the product's efficacy.

Poloxalene is a nonionic surfactant that has been used for the prevention of legume bloat for nearly 25 years. It is also used for the prevention of wheat pasture bloat (6). It was originally selected as a palatable and economical supplement that acted rapidly; prevented bloat for at least 12 h after a single administration;

Agriculture Canada Research Station, 6660 N.W. Marine Drive, Vancouver, British Columbia V6T 1X2 (Hall) and Agriculture Canada Research Station, 3015 Ord Road, Kamloops, British Columbia V2B 8A9 (Walker, Majak).

The supplements were donated by SmithKline Beecham and Alberta Agriculture.

Table 1. Number of cases of bloat[a] in steers fed fresh alfalfa with or without supplements

Supplement	Bloat	Exposure[b]	p^c
Trial 1			
None (control)	32	48	
Mineral mixture	22	48	0.007
Trial 2			
None (control)	37	51	
Mineral mixture	42	51	0.94
Poloxalene	0	51	<0.0001

[a]Visible distention of one or both flanks
[b]Number of steers x number of days on test
[c]One tail probability for test of treatment less than control

and did not deleteriously affect health, reproduction, rumen function, feed intake, or quality or quantity of milk (7). The results from the poloxalene treatment were compared with those from the one to three-day period prior to treatment in three trials, and the reduction in bloat incidence was found to be significant. Another trial was carried out with a concurrent control group, but it lasted only two days and used only two pairs of twins. No significant treatment effect was observed. In a later study (8), poloxalene reduced the incidence of bloat in treated cattle by 100% compared with that in the same cattle in the period prior to treatment. Because the daily bloating potential of alfalfa can vary widely, comparison of the effects of treatments with observations from a pretreatment period is not fully satisfactory. A reevaluation of poloxalene in a comparative trial in which control and treated cattle were evaluated concurrently would be useful.

The purposes of this study were to determine the efficacy of SHMM and to reevaluate, in a comparative trial, the efficacy of poloxalene for preventing alfalfa bloat.

Materials and methods

Two trials were carried out at Kamloops, British Columbia, to evaluate SHMM and poloxalene. The composition of SHMM was 37% salt, 23% monosodium phosphate, 20% air-slaked lime and hydrated magnesium oxide in a 4:1 ratio, 10% wheat bran, and 10% dried molasses (2). The poloxalene tested contained 53% poloxalene (Bloat Guard, SmithKline Beecham, Mississauga, Ontario). In the first trial, a group of three steers fed a control diet was compared with a second group of three steers fed the same diet, supplemented with SHMM in a two period, crossover design. The trial was carried out between May 21 and June 9, 1992. In the second trial, carried out between August 6 and 30, 1992, SHMM and poloxalene were both compared with the control. The experimental design was a 3 x 3 Latin square with three treatments, three time periods, and three groups of three steers each.

Each group of three Jersey steers with rumen fistulas used in the trials occupied a single pen. All of the steers were susceptible to bloat, as determined in previous trials, but none were chronic bloaters. They were cared for under the guidelines of the Canadian Council on Animal Care (9). Each pen was supplied with 200 kg (67 kg/head) of alfalfa herbage at 0830 each day. The pens were checked for remaining feed at 1530. The alfalfa, in the vegetative to early bloom stages of growth, was cut daily with a flail-type forage harvester and fed within 0.5 h of cutting. Each day, a sample of the alfalfa was taken, freeze-dried to a shelf temperature of 65°C, and ground through a 1 mm screen in a Wiley mill (Thomas Scientific, Philadelphia, Pennsylvania, USA). The acid detergent fiber (ADF) (10), neutral detergent fiber (NDF) (11), total and soluble nitrogen (12) contents, and the sodium, potassium, calcium and magnesium concentrations (13) were determined for each sample.

In the first trial, the steers ranged from 528 kg to 610 kg in body weight (BW) and SHMM was given at 100 g/d, which is the rate specified by the manufacturer. In the second trial, body weights ranged from 528 kg to 756 kg, and a rate of 190 mg/kg BW per day was used for administering SHMM to compensate for the wider variation in body weight. Poloxalene was given at 23.3 mg/kg BW per day, as specified by the manufacturer for conditions of severe bloat. All treatments were given intraruminally per fistula at 0800. Water, cobalt iodized salt, and cattle mineral (12% calcium and 12% phosphorus) were always available.

Observations of the occurrence of bloat were made 0.75–2.0 h after the beginning of feeding, when the ruminal cannulas were opened to relieve gas pressure. A steer was classified as bloated if it showed visible distention on one or both flanks prior to the opening of the cannula. A single steer bloating on one day was counted as one case of bloat. A trial period continued until the number of cases over all treatments totalled >24. Then the treatments were switched, and the steers were allowed to adjust to the new treatments for three days before recording commenced in the next period. During the three days adjustment periods in the trials, the diet was changed to alfalfa hay, which did not provoke bloat, to allow the steers to recover from the stress of bloating. Although some bloat occurred in the afternoon in the second trial, it was always preceded by bloat in the morning. A steer that bloated both morning and afternoon was still counted as one case of bloat.

The proportion of days on which each animal bloated was calculated in each period. Analysis of variance was carried out on these proportions to test effects of the treatments on the occurrence of bloat. Pairwise comparisons were carried out with Fisher's least significant difference test. Differences in alfalfa composition between trials were tested using analysis of variance. A significance level of 0.05 was used throughout.

Results

The bloat potency of the alfalfa was very high during the summer of 1992. The incidence of bloat in untreated control steers from these and our previous trials was 66%. The incidence rates among untreated control steers in the two feed supplement trials were 67% and 73%, respectively (Table 1). These rates were much higher than the 33% that has been observed in the past (1), and the conditions provided an excellent opportunity to test treatments for bloat prevention.

In the first trial, SHMM reduced the number of cases of bloat by 31% compared with the controls (Table 1).

Table 2. Chemical composition of alfalfa used in the two trials

Component	Trial 1	Trial 2	SEM	p^a
Dry matter (DM), %	25.8	22.5	0.5	0.0001
Acid detergent fiber, % DM	26.6	27.4	1.2	0.67
Neutral detergent fiber, % DM	37.9	34.9	1.5	0.17
Total nitrogen, mg/g DM	31.1	33.5	1.2	0.16
Soluble nitrogen, mg/g DM	13.2	14.8	0.5	0.02
Sodium, % DM	0.10	0.09	<0.01	0.16
Potassium, % DM	2.68	2.62	0.09	0.61
Calcium, % DM	1.68	1.79	0.04	0.06
Magnesium, % DM	0.32	0.36	0.01	0.01

[a]Two-tail probability for test of difference between trials

In the second trial, SHMM did not differ significantly from the control, but poloxalene eliminated bloat completely. There was little difference in response among the steers. The number of days with bloat for individual steers ranged from 7 to 12 in the first trial and from 7 to 11 in the second.

The dry matter (DM) content of the alfalfa was lower in the second trial than in the first (Table 2), but magnesium and soluble nitrogen were slightly higher. There were no other significant differences in the composition of the alfalfa between the trials.

Discussion

Though statistically significant, the differences in DM, magnesium, and soluble nitrogen were not large compared with the natural variability of alfalfa. The trials were carried out in different months using alfalfa from different cuts and the lengths of the trials were, necessarily, different, so the alfalfa was not identical. The DM content of the alfalfa was similar to that previously observed (14), but ADF was 10% higher, total nitrogen was 6 mg/g lower, and soluble nitrogen was 4 mg/g lower than in other years. Higher ADF and lower nitrogen concentrations were unexpected in a year with a high occurrence of bloat, because, within years, bloat is associated with alfalfa that has lower ADF and higher total and soluble nitrogen (14). The concentrations of sodium, potassium, calcium, and magnesium were similar to those observed in other years.

The differences between treatments cannot be attributed to differences in feed intake. The steers consumed all the feed presented to them in both trials, so there was no evidence that either treatment affected feed intake. Previous reports (7,15) have also indicated that poloxalene does not reduce feed intake. The number of cases of bloat did not differ markedly among steers. Because of this similarity among steers and because a crossover design was used, the differences among treatments cannot be attributed to the exceptional behavior of one or two steers.

The different results for SHMM in the two trials may reflect differences in the bloat potency of the alfalfa. A supplement may have an observable effect when the potency of the alfalfa is moderate, but not when potency is extremely high. Compared to that used in the first trial, the alfalfa used in the second trial had slightly less DM and a higher concentration of soluble N; both of which have been associated with more bloat (14). In eight cases in the second trial, bloat occurred both morning and afternoon, but, in the first trial, bloat never occurred in the afternoon. These observations suggested that the alfalfa was more potent in the second trial than in the first.

The SHMM reduced the occurrence of bloat by 31% in the first trial but was ineffective in the second, when the potency of the alfalfa may have been greater. While SHMM provided some protection, the reduction in the first trial fell far short of the ≥ 90% which we consider desirable for bloat prevention. In contrast, poloxalene was completely effective in preventing bloat when the dose specified for these severe conditions was used. This confirms results for poloxalene previously reported.

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